

Draft

**RETROREFLECTIVITY SIGN VAN
OPERATOR'S MANUAL
DECEMBER, 1999**

EQUIPMENT DESCRIPTIONS

The following are descriptions of the major components of the Retroreflectometer as well as their functions:

THE TURRET



There are three main components to the turret:

- (1) A main flash unit - a Xenon flash tube located at the lower portion of the turret,
- (2) Laser range finder located above the main flash unit, and
- (3) Three cameras - one 50 mm monochrome lens; one 75 mm monochrome lens; and one 50 mm color tracking camera.

The turret is able to rotate 180 degrees for storage; however, its rotation is limited to less than ± 80 degrees while in operation. This is a built-in safety feature so that during operation (tracking), the mount's position is limited to the general area of where the sign would be and won't "run away with itself" thus becoming uncontrollable.

Stow Pins

Located below (almost underneath) the turret are the stow pins. The main function of the stow pins are to prevent the turret from tipping while the van is moving with the system off. It is also important to note that the mount will not move if the stow pins are not in their storage location (at the base of the turret) during operation.

Stow Pin Positions (Non-operational Turret Storage)

The normal non-operational position for the unit (the turret) is backwards, that is, when the Turret is "stowed," the front of the unit is facing in the direction of the back of the van.

Operator Station



Driver Electronics -

The Driver Electronics is a black box located on the floor and to the left of the operator station. The Driver Electronics (for the mount) contains the power supply for the laser and one to two small custom electronic boards for camera shutter control.



Flash Power Supply -

Above the Driver Electronics box is a silver box which is the Flash Power Supply. It provides energy to activate the camera's flash.

Inverter



The Inverter is located underneath the passenger seats. It provides 2,000 watts of power and its function is to convert 12 volts of automotive power to 110 volts of AC. It is the main power supply - it gives power to all retroreflectivity components in the vehicle including the work station (everything that is powered by AC). For these vans, there are two different versions of inverters. Three of the vans have inverters which contain switches and plugs in the front of the unit (these are beige in color). One van has an inverter which does not contain any outward plugs or switches. Instead, this model has plugs wired within the box and the operating switch is located along with the other van controls - it is white in color. When external power is available, for example during trade shows, the AC can be removed from the inverter and plugged into an extension cord (or power strip) attached to external 120 volts.



Also, within the back of each van are 2 deep-cycle marine batteries that can provide power to run the inverter for up to 1 hour with the van's engine off. These batteries are charged by vehicle power (via the van's alternator). While the van is running (the motor is on), the batteries are always charging. However, there is isolation between the vehicle's batteries and the batteries used for the inverter and operator station to prevent the marine batteries from discharging back through the van's electrical system. The vehicle's (heavy duty - 190 amp) alternator feeds them both.



Display Monitor and keyboard -

All vans have the same style (flat) computer monitor, keyboard and software installed, as well as the same standard color (black). The monitor is a 13.1 - 13.8 inch flat panel. The primary reason for the flat monitor vs. a regular monitor is that the image on a flat monitor is stable even when the van isn't (the same isn't true with a regular monitor.) Also there is the issue of depth. The flat monitor doesn't interfere with the driver's view of the side view mirror.

Computer Hardware



Zip Drive -

For all vans, the operator's station will include the following:

- One Dual Pentium 200 - 233 Mhz Machine,
- One IOMEGA - 100 megabyte zip drive,
- One CD ROM drive,
- One 2-gigabyte removable,
- One 2 to 4-gigabyte internal hard drive and standard floppy drive, and
- 64 megs of RAM

The primary purpose of the zip drive is to give data to the persons who are participating in the demonstration. The computer is capable of retaining up to an hour's worth of data including, reflectivity, images - both black and white and color, and putting a viewing package together. It's a SCSI-based system, which allows maximum data speed between peripherals and the CPU.

Hard Drive -

2.1 gigabytes will store up to 1 day's worth of data.

Storing data -

Data is stored directly on the internal 2.1 Gig hard drive and then is transferred to the removable drive that can later be taken back to the office and downloaded to another computer, tape, etc.

Cooling Fan -

At the base of the monitor is the cooling fan. While the van is in operation, the excessive heat generated from the use of the computer (which can greatly affect the heat-sensitive components) is not really a concern while air conditioning from the van is available. However, during demonstrations when the van is stable (with it's motor turned off) and the doors are open, temperature is not (always) easily controllable. It is under these conditions that the built-in cooling fan is most useful in eliminating potential (overheating) problems.

Fold Down Table -

Each operator station includes a fold down table, which while in the "up" position allows for easy access to and from the seat. (This is important due to the limited amount of space for the "Operator's Station."



Fuse Box -

Located directly behind the computer monitor and drives (in front to the right of the driver's seat), is the power supply box for the three cameras (located in the turret). In the supply box are four fuses and three LEDs. If any or all of the LEDs (indicator lights) are out, this indicates that one or all fuses are out. To discover this, look at the lights which are labeled accordingly, to see if any are out. The last fuse labeled is the AC fuse. Lights on indicate power going to the cameras.

SOFTWARE/DISPLAY OUTLINE



1. The Image Controls (left side of screen)
2. The System Status Calibration Box (across the top of the screen)
3. The Range Finder (across the bottom of the screen)
4. Menus (right side of screen)

Rotating Beacon



The Rotating Beacon is a small orange light located on the roof of the van behind the turret. It is used to warn other road users that a possibly hazardous operation is in progress.

SOFTWARE DISPLAY



Under Functions Menu box

These are functions you can choose from the function drop-down menu, shown in figure

Operate View - used for operation

Demo View - used for van demonstrations in trade shows

Calibrate View - brings up screen calibrations for video, mount and sign(s). Normally, the video and mount settings are already calculated and established/set - the operator doesn't have to concern his/herself with this feature.



**Brightness and Contrast controls are located on the left side of the screen*

Brightness Value - is strictly a display feature and does not affect the settings of the camera(s) nor the contrast.

Contrast Value - Also, does not affect the settings of the camera or of the tracking. It merely changes what the operator sees (on the screen).

Delay Value - The Delay Value should NEVER be changed. It is the time difference between when the system gives the command to “flash” and the message gets to the (computer) card (designed by the van’s engineers). The delay synchronizes the light from the flash with the shutter opening so that the image is taken as close to the peak brightness as possible. In other words, it is the delay from the vertical sync pulse of the camera and to where it flashes within the frame. This delay is approximately 10 microseconds. It’s slightly different from every shutter position.

View Menu - Allows the operator to change the Brightness and Contrast values. Once changed, the numbered values will be stored, as well as the color shutter positions (which can also be changed when at this menu). This affects the camera, the black and white shutter, and the measurement.

Mouse Button Functions

The system uses a 3-button mouse.

The *left mouse button* - The mount’s aim moves immediately to the clicked point on the screen. This can be used while in motion as a course single step to a given location. However, this doesn’t initiate track so the clicked point quickly moves from under the “crosshairs” cursor when used under motion.

The *middle mouse button* - This is the “go to” button. If the button is pressed (held down) while moving the mouse, the mount is able to follow the cursor as the mouse is moved. The mount will stop at whatever point the operator stops moving the mouse. This button can be used to initially find the sign in the image before initiating track. Once the desired sign is positioned in the center of the screen, the right mouse button can be pressed.

The *right mouse button* - This button is identical in operation to the middle button, with the additional function of initiating tracking. A red square appears on the screen when an object is actively tracked. The position of the red square shows where the computer will move the mount when the right mouse button is released, which will activate the auto track function. The red square should be in the center of the screen directly over the green square. All signs should be manually aimed with the right mouse button depressed into this green square and the red tracking square should align over the green square when correctly tracking the sign. Slight movement of the red tracking square is normal. Once the red tracking square is consistently over the green square, the right mouse button can be released. The sign will now be tracked until the snap distance is reached.

Definition: Snap- the flashing and capturing of the sign’s retro-reflective image.

NOTE: The system must be monitored while the sign is actively tracked. If an object, such as a tree, interferes with the tracking function, the mount and the red square will travel off of the desired sign. The operator must reinitiate the track with the right mouse button on the desired sign. Depending on the operational environment, this may happen several times before the snap occurs. If great difficulty is had in auto tracking the sign, the operator may have to manually track the object with the right mouse button depressed.

If the tracking system doesn’t “lock” onto the desired object (i.e., a sign), but rather, locks onto another object (i.e., a truck), the tracking angle may go beyond the pre-established, software limits of the mount. The software program has a built in command that will cause the tracking system to automatically return to a setting of zero, zero (0,0) and the tracking at this point will be off. At this point, the operator must redesignate the sign to be tracked. Tracking will not occur beyond +-80 degrees azimuth and -9 degrees to 25 degrees elevation. The system will permit tracking beyond these limits in the ‘demo mode’.

Auto Return to Center -

If ‘auto return to center’ is checked, the mount returns automatically to aiming straight ahead and level after each snap. If ‘auto return to center’ is not checked, the mount will stay where it was before the snap. In other words, If ‘auto return to center’ is checked (set) the aim point automatically returns to the center after every camera snap.

Set-Up Menu -

When looking at the SET UP menu, a “default set up” is already in place. The values that were last stored in the registry, including the Brightness values, whether or not the Status Bar and Tool Bar was turned off, the same values will reappear until they are manually changed. Also, the set-up values are never the same from one session to the next. The values have to change.

The color shutter is very interactive. It depends on variables such as weather conditions (overcast - cloudy, days), the location of the vehicle (under bridges), etc.

The black and white shutter is something that is determined by the intensity of the sign. For brighter signs, the set-ups have to be changed so that the view isn’t completely saturated or “white-out.” For weaker signs, the set-ups have to be changed such that the sensitivity of the lens is increased. It is recommended that the operator begin with viewing values of around 4 or 5 (making changes as necessary while viewing the screen). The changes can be made under Operate View — located under the Functions Menu option.

Other Descriptions:

Auto Store Data Set -

This setting will store data captured for each sign reading (in incrementing file names). If not set, the system snaps a picture of the sign, but doesn't store any data.

The range designation is measured in feet by default, but can be switched to metric. This number changes based on the image being viewed. There is a range sensitivity of 3-4 feet.

Signal strength (laser) is 50-90%. This is so a good return from the sign is achieved.

As mentioned earlier, for the purpose of conducting demonstrations, there is 45 minutes to 1 hour of full charge when running the system using the battery without aid from the van's engine. After that, the operator runs the risk of having the entire system shut down (and possibly losing valuable information).

System status - Shows operational condition of system. The values can be "standby", "storing data", "Finding Home" or "tracking". The system is generally in standby mode.

Image Quality - Refers to the tracking parameter for the van. It sometimes indicates how well the equipment is tracking.

Data Index - The index into the data set that the operator is running on at any given moment. This feature shows the number of images which have been stored.

Master File Name - This does not change in a session unless the operator goes to the file (menu) and then to the "new" or "save as" (option) which automatically assigns a new data index and data set name (which has embedded in it the julian date, year and 24 hour time in minutes)

Also, within the 'data set' is an index number for each point taken. The data is stored in separate files with separate file names with black and white images as well as color images. The data set name is different. There are three types of files that can be stored in this system. Each image is a separate file. This is automatically assigned by the system.

The default file naming convention is the following:

Data set master file (smarts file type): DataSet(julian day of the year)(hr and min of first sign collect)(yr).smd i.e.: DataSet142183498.smd - 142nd day of 1998 at 18:34 hrs

Black and white bitmap image file: BW(julian day of the year)(hr and min and sec of specific sign collect)(yr).bmp i.e.: BW14219053398.bmp - 142nd day of 1998 at 19:05.33 hrs

Color bitmap image file: Color(julian day of the year)(hr and min and sec of specific sign collect)(yr).bmp i.e.: Color14219053398.bmp - 142nd day of 1998 at 19:05.33 hrs

Set-up and Alignment:

First, the Stow Pins are to be taken down and placed in the drive position (being most concerned about the elevation pin)

Next, sit at the operator's station and turn on the inverter (beige box under passenger's seat directly behind the operator's seat). The monitor will "power up" and the computer can be turned on. DO NOT turn on the drive electronics box until the program is running. As the computer is "booting up" go through the NT login (which is a standard NT login). Once the computer displays a login screen, simultaneously hit the "CTRL", "ALT" and "DELETE" buttons. Next, enter the given "user level/demo level" password. At this point an icon for the "Shortcut to Smart EXE" should appear on the desktop. Double click on it. This brings the program up and if it isn't already, you should enlarge it to full screen.

Once the program is up, **NOW** turn on the driver electronics box as well as the flash (the silver box above the driver electronics box).

PLEASE NOTE: The program must be up before the driver electronics box can be turned on.

Now, adjust the color shutter so that a clear picture is obtained.. The color shutter “box” as well as the black and white shutter “box” is located in the bottom left corner of the screen. Use of the up and down arrow keys will also allow the operator to adjust the color shutter. Next, find the home button and use it to find mount home position. It takes approximately 30 seconds to find the mount home position. Each time the computer and the mount are turned on, the system must find “home” first. It will show the “as now position” to be “0,0”. This is displayed at the top of the screen. The “0,0” position reading is the reference point by which all measurements are taken.

Calibration:

In order to perform calibrations, the object to be calibrated has to be placed 200 ft away from the van, as determined by the laser range value. Once an item has been identified for calibration, & placed at the correct distance, the operator will enter a lab-determined value for the calibration sign after pressing the “Sign Calibration” button of the “calibration view” function window. Next, the system will determine the bias value & then the scale value for that particular sign.

NOTE: Before beginning to take a bias value reading, the top portion of the turret, where the cameras are located, must be covered with a black sheet of cardboard. The entire turret does not have to be covered. However the area of the camera must be entirely covered.

Bias value- Refers to the measurement of the black bias of the camera (the measurement of the black background noise).

Scale value - Refers to the multiplying value of a line equation ($y = \text{scale} * x + \text{bias}$) . Calculated from the bias and the known measured value of the calibration sign (y).

To conduct bias calibration, simply place a black board in front of the cameras and press the “bias calibration” button. When the camera flashes, the bias calibration will be for the image taken (dark screen). The computer will measure the entire area. The operator should remember to make sure that the board used is blocking all direct sunlight to the camera(s). A 50 mm or 75 mm lens will be used for this purpose.

Next choose “gain calibration”. The system will flash and show the operator the entire image. If there is one sign with the image, the red square will be around it (the one sign) and will automatically select it. In cases, where this doesn’t happen automatically, the operator will select the desired image, using the left mouse button to put the red square around any part of the (white) sign, after which, a new gain value will be assigned. Thus, the sign will be calibrated using the lab value given.

In summary, the sign is calibrated using calibration values for the sign selected based on its measured lab value. The operator calculates the bias which is the background “noise” of the camera and then calculates the gain value based on the reflectivity measured from the area of the high-lighted sign (using the red box) & only that which is contained within the red box.

Once the calibration is taken, it’s value will be used to calibrate all future measurements, until another calibration is taken.

NOTE: The operator does not have to calibrate differently based on different sign colors. Also, if the CANCEL button is pressed, all new calibrations will be discarded and the previous values reinstated. Therefore, it is important to save the data collected, by selecting the “OK” button (this will store the values collected). When taking measurements and doing calibrations, it is preferred that all-white signs are used. Also, when trying to take a measurement on a sign, the view of the sign must be placed within the red box.

Data Capture/Data Transfer — Operate View

Start and Stop Tracking- The operator has to be in the tracking mode in order to start and stop tracking

Mount Controls - Is a pull down menu, which does the same as the tool bar buttons of the same name.

These are the options (selections):

Find Home - go to zero, zero (Must be used once at each power up to locate forward and level for the mount controller.)

SF - Store Forward

SB - Store Backward

Reset Mount - Reset mount

(All of these features are located on the tool bar)

Reset (button) - This button resets the camera and mount (“wakes up” the mount from any unusual location/position it may be in). This button doesn’t change any pre-established values, positions or calibrations.

50 mm camera or 75 mm camera - Determines which black and white camera is used for data capture.

Demo view -

This option is used for conducting demonstrations at a site. The operator will get a new screen that is almost identical to the “Operating View” screen. The buttons are in the same location as the ‘view’ feature (operate view) with a few additions the additions are:

Under DEMO CONTROL

Start demonstration

Stop demonstration

Set demonstration

Both the ‘Start’ and ‘Stop’ demonstration controls are self explanatory

The ‘Set demonstration’ (show mode) feature allows the operator to select a particular point in a scene (within the aiming square - limited by the travel distance of the turret) that sets the selected point of reference. The aiming point will simulate a search mode by tracking around the screen for two or three minutes at a time. Once away for two or three minutes, it automatically returns to the selected reference point and will randomly flash, take a black-and-white image of the sign and then return to random motion.

While in the ‘Show Mode’, the color shutter and the black-and-white shutter are functional

Flash Only -

This feature does just that. It flashes only and does nothing else - it remains in the black-and- white mode.

Demo Mode -

To use this feature, move the middle mouse button or left tracking button and the system will override the demo (which is still running) and move the aimpoint away from section initially selected. During a demonstration, click on a sign and select ‘flash only’ — the camera will flash the sign and keep the black and white image of it. At this point, if the operator returns back to the ‘mono’ option, and the image is lost.

Flash & Process -

This option can be used to actually store the data only if ‘auto store’ preference is selected. Auto return to center also functions in the ‘demo mode.’

System Shutdown

The following are the procedures necessary to successfully shut off the system.

1. Store turret (press the SB button - Store backwards button) This causes the turret to go to the stowed position. It stops at approximately 180 degrees. The operator should make sure the turret is properly aligned with the pin positions. The operator will put the pins in before shutting off the computer to insure that the mount does not drift.
2. Put the pins in the mount.
3. Turn the Black box (Driver Electronics) off. This will allow the operator to physically move the mount if step two was not done. Make sure that the pin and mount are properly aligned. If the Driver Electronics is not turned off at this point, it will be impossible to manually move the mount.
4. Next, press the “File Exit” button and then select “Start”, “Shut Down”. This turns the computer off (shuts down the computer)
5. Turn the computer power switch off
6. Turn off the Inverter under the rear seat.